Objections To The Specification

Numerous objections were made by the Examiner to the specification as containing informalities. These informalities have been corrected in the amendment.

Claim Rejections Under 35 USC §112

Claims 1-8 and 16-20 are rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Numerous claim language rejections were raised by the Examiner.

Claims 4, 6, 7 and 11 have been canceled and withdrawn from further consideration by the Examiner.

Claims 1, 8 and 16 have been amended to alleviate the Examiner's rejections. However, with regard to claim 1, wherein "a cooling liquid to flow therethrough" is recited. The Applicants fail to find insufficient antecedent basis since the claim language does not read "said cooling liquid" or "the cooling liquid".

Claim Rejections Under 35 USC §102

Claims 1-3, 6-10, 13-18 and 20 are rejected under 35 USC §102(b) as being anticipated by Moslehi '745.

Independent claims 1, 8 and 16 have been amended to include the additional limitations contained in their dependent claims 4 and 11. While independent claim 16 specifically recites the combination of at least three circular grooves and at least two linear grooves which were not taught, disclosed or suggested by Moslehi.

The rejection of claims 1-3, 6-10, 13-18 and 20 under 35 USC §102(b) based on Moslehi is respectfully traversed. A reconsideration for allowance of these claims is respectfully requested of the Examiner.

Claim Rejections Under 35 USC §103

Claims 4-5, 11-12 and 19 are rejected under 35 USC §103(a) as being unpatentable over Moslehi '745. It is contended that Moslehi discloses the invention essentially as claimed, except for not specifying the dimensions of the grooves to be exactly

within the ranges of the instant invention. However, the Examiner has taken the position that it is not inventive to merely optimize the size range of an element, such as the grooves in the instant case.

The rejection of claims 5, 12 and 19 under 35 USC §103(a) based on Moslehi is respectfully traversed.

Claims 4 and 11 have been canceled.

Moslehi '745 discloses a two-stage sealing system for thermally conductive chuck which is described in Figures 3, 6, 9 and at col. 7, lines 3-15. While Moslehi discloses a plurality of circumferential and radial channels or grooves 88 and 90 formed in the mounting surface 70, the exact size, i.e. width and depth, of the grooves were not disclosed by Moslehi at all. The Applicants respectfully submit that in order for the present invention cooling stage to function, the width and depth of the groups are utmost important and their criticality have been shown by the Applicants in the specification. For instance, at page 12, lines 14-20:

> "For instance, a suitable width for the grooves may be between about 1 mm and about 7 mm, preferably between about 3 mm and about 5 mm. A suitable depth of the grooves may be between about 1 mm and about 7 mm, and preferably between about 1 mm and about 3 mm. In the grooves 74 shown in Figure 3B, the width and the depth of the grooves are approximately the same, i.e., at about 2 mm. The width and depth of the grooves may be **suitably selected depending on the total area of the cooling stage and the characteristics of the substrate surface** to be cooled."

When the suitable size of grooves are formed, the present invention achieves the desirable purposes, as shown on page 13, lines 4~14:

> "For instance, the novel apparatus **completely eliminates the wafer jump defect** observed during cooling of a hot wafer on a smooth surfaced stage. Secondly, the present

invention novel apparatus effectively **prevents wafer from being sucked on the cooling stage due to a vacuum effect** when a wafer is placed on a smooth surfaced cooling stage. The cooling grooves effectively prevent wafer from adhering to the cooling stage and thus **avoid unnecessary mechanical stresses on the wafer.** Thirdly, the present invention novel cooling stage effectively **prevents wafer from sliding on a cooling stage due to an air cushion effect** which otherwise causes a dislocation of the wafer on the cooling stage. The present invention novel apparatus and method **uniformly cools a wafer (or a semiconductor substrate) on both its top surface and its bottom surface** such that **an imbalance in thermal stresses can be avoided** to avoid a dislocation of the wafer on the cooling stage."

The Applicants therefore respectfully submit that in the present case, the criticality of the various sizes of the circular and linear grooves have been shown by the Applicants in the specification.

The rejection of claims 5, 12 and 19 under 35 USC §103(a) based on Moslehi is respectfully traversed. A reconsideration for allowance of these claims is respectfully requested of the Examiner.

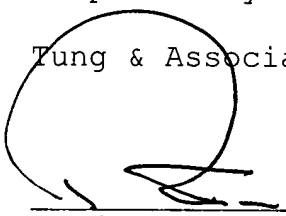
Based on the foregoing, the Applicants respectfully submit that all of the pending claims, i.e. claims 1-3, 5, 8-10 and 12-20, are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

Attached hereto is a marked-up version of the changes made to the Specification, Claims and Abstract by the current amendment. The attached page is captioned "Version With Markings To Show Changes Made".

In the event that the present invention is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

Tung & Associates



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Specification

Paragraph beginning at line 12 of page 1 has been amended as follows:

> -A frequently used fabrication technique in the manufacture of semiconductor devices involves the deposition of a metallic layer on the surface of a wafer. The deposition process utilizes a thin metal coating to cover steps such as in vias or contact holes that have diameters in the submicron range. The process is essential for achieving precise pattern alignment and reliability in fabricating VLSI (very large scale integration) and ULSI (ultra-large scale integration) devices.-

Paragraph beginning at line 5 of page 2 has been amended as follows:

-A conventional sputter apparatus that is used to fill trenches or contact holes arranged in a cluster form is shown in Figure 1. The cluster tool 10 consists of four physical vapor deposition chambers 12, 14, 16 and 18 arranged surrounding a transfer chamber 20. On the other end of the cluster tool 10, a number of auxiliary chambers 22, 24, 26 and 28 are arranged surrounding a buffer chamber 30. Further surrounding and in fluid communication with the buffer chamber 30 are the load lock chambers 36 and 38. The buffer chamber 30 and the transfer chamber 20 are both equipped with a wafer transfer robot 32 which is equipped with a robot blade 34. The cluster tool 10 is mounted in a wafer [fab] <u>fabrication</u> facility by through-the-wall installation such that the load lock chambers 36, 38 face the clean room and the process chambers 12~18 are located in a service area. The load lock chambers 36, 38

are used for load and unload wafers into and out of the cluster tool by a machine operator.

In The Abstract

Please amend the Abstract as follows:

-A cooling stage for a semiconductor substrate and a method for utilizing such cooling stage for improved cooling of a semiconductor substrate are [provided] disclosed. In the cooling stage, a pedestal that has a substantially planar top surface is equipped with a first plurality of circular grooves concentrically formed in the top surface and a second plurality of linear grooves formed in radial directions emanating from a center of the top surface in fluid communication with the first plurality of circular grooves to allow a cooling fluid to flow therethrough when a semiconductor substrate is positioned on the top surface of the stage. The [present invention novel] apparatus and method [is] are effective in preventing wafer jump or wafer

sticking problems frequently caused by an imbalance of thermal stresses in a top surface and a bottom surface of a wafer that is inadequately cooled on a cooling stage.-

In the Claims

Claim 1 has been amended as follows:

1. (Amended) A cooling stage for a semiconductor substrate comprising:

a pedestal having a substantially planar top surface,

a first plurality of circular grooves concentrically formed in said top surface, and

a second plurality of linear grooves formed in radial directions emanating from a center of said top surface in fluid communication with said first plurality of circular grooves allowing a cooling fluid to flow therethrough when said semiconductor substrate is positioned on said top surface of the pedestal[.] , said first plurality of circular grooves and said second plurality of linear grooves each having a width between about 1 mm and about 7 mm, and a depth between about 1 mm and about 7 mm.

Claims 4, 6 and 7 have been canceled without prejudice.

Claim 8 has been amended as follows:

8. (Amended) A method for cooling a semiconductor substrate comprising the steps of:

providing a cooling stage comprising a wafer pedestal equipped with a grooved top surface thereon, said grooved top surface comprises a first plurality of circular grooves concentrically formed in said top surface and a second plurality of linear grooves formed in radial directions emanating from a center of said top surface in fluid communication with said first plurality of circular grooves, <u>said first plurality of circular grooves and said second plurality of linear grooves each having a width between about 1 mm and about 7 mm, and a depth between about 1 mm and about 7 mm,</u>

positioning a heated semiconductor substrate on said grooved top surface,

flowing a cooling liquid through a cooling channel in said wafer pedestal to carry away [hat] <u>heat</u> transferred to said grooved top surface, and

flowing a cooling gas through said first and second plurality of circular and linear grooves to carry away heat from a backside of said heated semiconductor substrate.

Please cancel claim 11 without prejudice.

Claim 16 has been amended as follows:

16. (Amended) A wafer pedestal effective in cooling a high temperature processed wafer comprising:

a wafer pedestal having a substantially planar top surface,

at least 3 circular grooves concentrically formed in said top surface, and

at least 2 linear grooves formed in radial directions emanating from a center of said top surface in fluid communication with said at least 3 circular grooves [such that] <u>for flowing</u> a cooling fluid <u>therethrough</u> [flows through said circular and said linear grooves to cool] <u>cooling</u> said high temperature processed wafer positioned thereon.